## Technical and Professional Education

# Curriculum Content Frameworks for Geospatial Technology

**Curriculum Content Frameworks for**
**Geospatial Technology**
**Developed by the**
**Department of Workforce Education**

**State of Arkansas**
**Department of Workforce Education**

# NOTICE TO THE READER

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# Preface

The Technical & Professional Education program continues to prepare students for employment and continuing education. To accomplish this preparation, teachers and employers have collaborated to modify individual programs to ensure that instruction is current and comprehensive. This document reflects essential competencies for program completers as well as all aspects of the Geospatial Technology Industry as required by the Carl D. Perkins Act. The Curriculum Content Frameworks for all Technical & Professional Education programs can be accessed through the Department of Workforce Education Web site.

# Forward

The curriculum content framework Geospatial Technology supports the course that prepares students for the following career roles, which in turn correspond to the CIP (Classification of Instructional Programs) codes listed below. The courses may be sequenced with a variety of career and technical courses to form a specialization to prepare students for careers and support additional education and training in the geospatial technology industry.

- Career Family: Science. Technology, Engineering and Mathematics
- Career Area: Engineering and Technology
- Career Role CIP Code: 15.1102 Surveying Technology/Surveying
  45.0702 Cartographer
  143.062-014 Arial Photographer
- O-NET : 17-1021.00 Cartographers and Photogrammetrists
  17-1022.00 Surveyors
  17.3031.01 Surveying Technicians

# Acknowledgments

The Geospatial Technology curriculum content framework was produced by a team of program developers from the University of Arkansas at Little Rock and representatives from industry and education. A panel of experts in the field of reviewed the framework. The format and content of the framework reflect the specific training needs within the state of Arkansas. The framework content and format is modeled after a document originally developed by a writing team under the auspices of the Virginia Department of Education. Grateful appreciation is expressed to the Virginia Department of Education for granting the Arkansas Department of Workforce Education access to their instructional frameworks.

# Table of Contents

# Introduction

## About the Program

Geospatial Technology prepares students for careers in the geographic information and spatial imaging industry. The course sequence focuses on duties and tasks performed by professionals in geospatial technology, spatial imaging and surveying as well as pre-employment and employment skills.

## About the Document

- Section 1 contains a master duty/task list for the Geospatial Technology program.
- Section 2 contains an analysis of each task, consisting of the task, task definition, and process/skill questions to evaluate acceptable performance. All tasks have been designated essential. Essential tasks are those that must be achieved by every student pursuing the completion of Geospatial Technology program.
- Section 3 lists the Arkansas Standards of Learning for language arts, mathematics, and science that are reinforced by instruction in the Geospatial Technology program. Academic skills in these areas are necessary for the mastery of a number of tasks performed by geospatial technicians on the job.

## Program Descriptions

494900 Introduction to GIS
494910 GIS and Remote Sensing
494920 Special Projects and Community Exchange (SPACE)
494930 Spatial Technology and Remote Sensing (STARS)

Introduction to GIS/Remote Sensing is designed to introduce students to Geographic Information Systems (GIS) and Remote Sensing (RS) technology through academic study and applied instruction. Students will be introduced to terminology and concepts relating to GIS/RS technology and will apply these concepts through the use of GIS software programs. Students will participate in structured, applied learning exercises taken from existing data sources. More advanced study uses GIS software extensions to work with local data sets, standard geospatial extension software and geospatial tools including global positioning systems (GPS), and training in GIS project manage.

# Geospatial Technology
# Master Duty/Task Listing

**Introduction to GIS (Geographic Information Systems)**
**GIS and Remote Sensing**
**Spatial Technology and Remote Sensing (STARS)**
**Spatial Projects and Community Exchange (SPACE)**

National and state experts in the occupational field of Geospatial Technology have validated the duties and tasks in this section. Each is analyzed by identifying the following:

- a *duty*/*task statement*, which describes what the student is to do

| **INTRODUCTION TO GIS** |
|---|
| **DUTY A:**<br>**Introduction to Spatial Technology** |
| **Task:** |
| A001: Terminology associated with spatial information technology and spatial relationships (including traditional cartographic, GIS, remote sensing, and related content) |
| A002: Terminology dealing with geographic data |
| A003: Stages of the traditional cartographic process |
| A004: Point, line, and polygon surface features on traditional and digital maps |
| A005: Functions of a GIS |
| **DUTY B:**<br>**Geographic Tools and Elements using GIS software** |
| **Task:** |

| |
|---|
| B001: Major sections of GIS software |
| B002: Local land features from existing themes using a GIS software Air Photo Browser |
| B003: Regional land features using satellite imagery |
| B004: Physical and human geographic elements using automated thematic maps |
| **DUTY C:**<br>**Geographic Relationships using GIS software** |
| **Task:** |
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| **DUTY D:**<br>**Building GIS Projects** |
| **Task:** |
| D001: Components of the GIS project management model |
| **DUTY E:**<br>**Skill-based Learning in GIS using GIS Software** |
| **Task:** |
| E001: Local news story with geographic interest to explore |
| **DUTY F:**<br>**Careers in GIS/RS** |
| **Task:** |
| F001: Uses and benefits of GIS/RS technology career fields |
| F002: Skills necessary for a career in GIS/RS |
| **GIS AND REMOTE SENSING** |
| **DUTY G:**<br>**Applications in Introductory GIS/RS** |
| **Task:** |
| G001: Major Components of GIS software |

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|---|
| **DUTY H:**<br>**Intermediate Applications using GIS/RS Software** |
| **Task:** |
| H001: GIS analysis |
| **DUTY I:**<br>**Introduction to GIS/RS Software Extensions** |
| **Task:** |
| I001: Image analysis of digital images |
| I002: Analysis of geographic networks |
| I003: Analysis of raster data |
| I004: Analysis of surface data |
| **SPATIAL TECHNOLOGY AND REMOTE SENSING** |
| **DUTY J:**<br>**GIS Software Extensions** |
| **Task:** |
| J001: Using GIS software extensions |
| J002: Applications in GIS software image analysis extensions |
| J003: Applications in GIS software network analysis extensions |
| J004: Applications in GIS software spatial analysis extensions |
| J005: Applications in GIS software 3D analysis extensions |
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| **Task:** |
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| **DUTY M:**<br>**Meta Data Creation from School-Based Application Data** |

| |
|---|
| **Task:** |
| M001: Federal Geographic Data Committee (FGDC) standards for meta data |
| **SPATIAL PROJECTS AND COMMUNITY EXCHANGE (SPACE)** |
| **DUTY N:**<br>**Introduction/Migration to Industry Standard Geospatial Tools** |
| **Task:** |
| N001: Understand concepts of industry standard GIS software |
| N002: Demonstrate industry standard GIS software tools |
| **DUTY O:**<br>**Applications in Community-Based GIS Class Project Design** |
| **Task:** |
| O001: Problem identification and need |
| O002: Data analysis |
| O003: Project presentation |
| **DUTY P:**<br>**Self-Guided Applications in Community-Based GIS Project Design** |
| **Task:** |
| P001: Problem identification and research |
| P002: Data analysis |
| P003: Project presentation |

# Geospatial Technology
# Task Definition Statements

**Introduction to GIS (Geographic Information Systems)**
**GIS and Remote Sensing**
**Spatial Technology and Remote Sensing (STARS)**
**Spatial Projects and Community Exchange (SPACE)**

National and state experts in the occupational field of Geospatial Technology have validated tasks in this section. Each task is analyzed by identifying the following:

- a *task definition* (criteria for acceptable performance), which explains what the student has to do to perform the task at the expected level of mastery
- *process/skill questions*, which assess student knowledge and performance.

Tasks are arranged by instructional duty area only. The placement of tasks into specific courses and the sequencing of tasks for instruction are local decisions based on student needs, employer demand, and school schedules.

| **INTRODUCTION TO GIS** |
|---|
| **DUTY A:**<br>**Introduction to Spatial Technology** |
| **Task:** |
| **A001: Terminology associated with spatial information technology and spatial relationships (including traditional cartographic, GIS, remote sensing, and related content)**<br><br>*Definition:* Process should include the following:<br>• explain geographic phenomena using spatial terminology<br>• interpret location using the geographic grid system<br>• create a scaled map using cartographic tools and techniques<br>• interpret thematic maps in a GIS<br>• determine the effect of map projections on two-dimensional traditional and digital map images<br>• identify existing sources and types of traditional cartography and automated data<br><br>Process/Skill Questions |
| **A002: Terminology dealing with geographic data**<br><br>*Definition:* Process should include the following:<br>• determine sources and types of traditional and digital geographic data<br>• identify remote sensing tools and techniques used to acquire data<br>• compare the differences in bandwidth data in satellite imagery<br>• identify issues dealing with remote sensing satellites in orbit<br>• simulate remote sensing satellite orbits using computer software<br>• identify terminology dealing with geographic data (spatial data, attribute data, vector data, raster data, image data)<br><br>Process/Skill Questions |
| **A003: Stages of the traditional cartographic process**<br><br>*Definition:* Process should include the following:<br>identify and describe the stages of the traditional cartographic process<br>• explain how GIS has added an analytical element to traditional cartography<br><br>Process/Skill Questions |

**A004: Point, line, and polygon surface features on traditional and digital maps**

*Definition:* Process should include the following:

- interpret point, line and polygon surface features using traditional and digital maps

Process/Skill Questions

**A005: Functions of a GIS**

*Definition:* Process should include the following:

- identify and describe the functions of a GIS
  - identify potential uses of GIS in business and community
  - demonstrate how GIS technology could be used, given a specific business or community case

Process/Skill Questions

**DUTY B:**
**Geographic Tools and Elements using GIS software**

**Task:**

**B001: Major sections of GIS software**

*Definition:* Process should include the following:

- demonstrate navigation of a GIS software program
- identify and describe the stages of the traditional cartographic process
- explain how GIS has added an analytical element to the traditional cartographic process

Process/Skill Questions.

**B002: Local land features from existing themes using a GIS software Air Photo Browser**

*Definition:* Process should include the following:

- create a mental map of the local community
- interpret local land features using an Air Photo Browser
- compare mental map to geo-referenced map
- utilize tools to add new map features to maps created from aerial photographs using an Air Photo Browser
- utilize tools to add new map themes to maps created from aerial photographs using an Air Photo Browser

Process/Skill Questions

**B003: Regional land features using satellite imagery**

*Definition:* Process should include the following:

- interpret regional land features using a GIS Satellite Imagery Viewer
- classify satellite images into major land cover classes
- convert image classes into map features
- determine land cover class, area coverage, and proportions

Process/Skill Questions

**B004: Physical and human geographic elements using automated thematic maps**

*Definition:* Process should include the following:

- discover geographic situations that exist among elements in physical systems including atmosphere, biosphere, lithosphere, and hydrosphere
- discover geographic situations that exist among elements in human systems including movement and settlement, cultural mosaic, economic activities, and political divisions
- identify terminology dealing with geographic data including: spatial data, attribute data, vector data, raster data, image data, etc
- identify physical geographic elements and human geographic elements using automated thematic maps

Process/Skill Questions

**DUTY C:**
**Geographic Relationships using GIS software.**

**Task:**

**C001: Geographic relationships among geographic elements**

*Definition:* Process should include the following:

- illustrate geographic relationships among physical and human systems
- infer how a particular geographic relationship has affected the local community or region

Process/Skill Questions

**DUTY D:**
**Building GIS Projects**

**Task:**

**D001: Components of the GIS project management model**

*Definition*: Process should include the following:

- identify the primary components to plan and execute a GIS project including: data input, data storage, data manipulation and analysis
- explore use of map legends
- explore use of legends in data manipulation for GIS projects

Process/Skill Questions

**DUTY E:**
**Skill-based Learning in GIS using GIS Software**

**Task:**

**E001: Local news story with geographic interest to explore**

*Definition*: Process should include the following:

- Report on a local news story with some geographic interest to explore
- determine geographic data needs for a project
- analyze existing data in order to make conclusions
- create maps, charts, and other visual aids to illustrate project
- theorize on additional data needs
- compile a written report outlining a GIS project, reasons for the data selected, and findings/conclusions
- present GIS project findings through use of oral presentation with visual aids

Process/Skill Questions Process/Skill Questions

**DUTY F:**
**Careers in GIS/RS**

**Task:**

**F001: Uses and benefits of GIS/RS technology career fields**

*Definition*: Process should include the following:

- utilize career exploration resources to locate information on direct and indirect careers in GIS/RS technology
- describe the uses and benefits of GIS in business, crime analysis, environmental/natural resources, health care, planning/urban development, public safety, real estate, and other fields
- identify and recognize skills necessary for careers in GIS

Process/Skill Questions

**F002: Skills necessary for a career in GIS/RS**

*Definition*: Process should include the following:

- develop planning strategies for future career opportunities in GIS/RS
- prepare and present a written project or computer presentation regarding a career in GIS/RS

Process/Skill Questions

**GIS AND REMOTE SENSING**

**DUTY G:**
**Applications in Introductory GIS/RS**

**Task:**

**G001: Major Components of GIS software**

*Definition*: Process should include the following:

- demonstrate navigation of a GIS software program
- create a map display by loading various data and images into a GIS software program
- classify and display various map themes
- use symbols and colors to express feature attributes
- determine distances and area among land features from mapped data
- determine how map scales may be changed to maximize the effectiveness of map analysis
- make queries by working with data in map form and in table form
- manage data in a GIS
- analyze spatial relationships through the examination of various thematic data
- present information generated from the GIS in the form of charts and maps that can be used to make decisions regarding geographic data
- create new GIS projects by generating new shape files and adding event themes, editing shape files, and geocoding new GIS data
- download geographic data from an online source to be used in a GIS project

Process/Skill Questions

**DUTY H:**
**Intermediate Applications using GIS/RS Software**

**Task:**

**H001: GIS analysis**

*Definition*: Process should include the following:

- utilize GIS software tools and functions to conduct GIS analysis to solve a geographic problem and/or illustrate a geographic situation

Process/Skill Questions

**DUTY I:**
**Introduction to GIS/RS Software Extensions**

**Task:**

**I001: Image analysis of digital images**

*Definition*: Process should include the following:

- Explore the use of image analysis to georeferenced and non-georeferenced digital images
- explore the use of image analysis to existing map features of a digital image
- categorize land cover types
- evaluate areas of change
- analyze digital images based on various criteria

Process/Skill Question

**I002: Analysis of geographic networks**

*Definition*: Process should include the following:

- locate the most efficient travel route between 2 points
- generate driving directions for a 100 mile trip
- locate the closest facility meeting designated criteria
- define a service area based on travel time

Process/Skill Questions

**I003: Analysis of raster data**

*Definition*: Process should include the following:

- create, query, map, and analyze cell-based raster data
- perform integrated vector-raster analysis using feature-based themes
- perform integrated vector-raster analysis using grid-based themes

Process/Skill Questions

**I004: Analysis of surface data**

*Definition*: Process should include the following:

- create, analyze, and visualize surface and other three-dimensional data

Process/Skill Questions

**SPATIAL TECHNOLOGY AND REMOTE SENSING**

**DUTY J:**
**GIS Software Extensions**

**Task:**

**J001: Using GIS software extensions**

*Definition*: Process should include the following:

- review purpose of GIS extension software
- determine which GIS extension software program(s) and features should be used for a specific GIS situation
- explore the use of various geographic projections in GIS software and GIS software extensions

Process/Skill Questions

**J002: Applications in GIS software image analysis extensions**

*Definition*: Process should include the following:

- categorize land cover types
- evaluate areas of change in images
- analyze digital images based on various criteria
- rectify geo-reference and non-geo-referenced digital images to existing map features
- rectify an image of the local community to a local street network using projection techniques and GIS image analysis tools

Process/Skill Questions

**J003: Applications in GIS software network analysis extensions**

*Definition*: Process should include the following:

- find most efficient routes, given various destination points
- generate directions from one point to another
- find the closest facility to a given location
- define service areas based on travel time
- determine a daily best route for personal use

Process/Skill Questions

**J004: Applications in GIS software spatial analysis extensions**

*Definition*: Process should include the following:

- create, query, map and analyze cell-based raster data
- perform integrated vector-rastor analysis using feature-based and grid based themes
- create a surface model of a local quad from contour data, computer hillshade, and build several queries using local data

Process/Skill Questions

**J005: Applications in GIS software 3D analysis extensions**

*Definition*: Process should include the following:

- create, analyze, and visualize surface data and other three-dimensional data
- convert a local surface model created using Spatial Analyst to TIN
- display the TIN in a 3D viewer mode
- use a legend editor to remove breaklines from the TIN
- copy other themes that have been reprojected to UTM earlier to the 3D viewer, (including the air photo that was reprojected using image analysis)

Process/Skill Questions

**J006: Topics in the Project Management Model**

*Definition*: Process should include the following:

- identify detailed steps involved in the design of a GIS project (including problem identification, entity/people interviews, data collection/observation, data manipulation, presentation of findings, and community forum/application of findings)
- explore factors involved with the initial design of a GIS project including: identifying tools needed for implementation, defining applicable geographic objects and their relationships, identifying the appropriate study area, and examining the availability of data
- explore tools that are used in the process of data collection
- explore the role of meta data in the data selection process and FGDC standards for meta data and utilize meta data to find and obtain data on the Internet
- identify potential GIS system flaws including poorly selected data, limited software, and others and explain how these flaws could contribute to poor system outcomes
- identify the functions or requirements of a successful GIS design
- identify internal (technical) issues dealing with GIS system design
- identify external (institutional) issues dealing with GIS system design
- identify internal players and external players that deal with GIS system design

Process/Skill Questions

**DUTY K:**
**Intermediate Applications Using GIS Software and GIS Software Extensions**

**Task:**

**K001: Develop a class-wide project in the context of the components of the Project Management Model**

*Definition*: Process should include the following:

- collect campus coordinate/elevation and feature data
- process collected data in order for it to be used with GIS software program
- import data into a GIS project
- edit data tables to include elevation values
- build a three-dimensional surface model of the school campus from coordinate/elevation data
- drape the aerial photograph and collected feature data to the three-dimensional campus surface model
- modify feature theme data properties to optimally display the features in the 3D scene
- create map layouts and other visual aids to illustrate project
- compile a written report outlining the project, reasons for the data selected, and findings/conclusions
- present project findings through use of oral presentation with visual aids

Process/Skill Questions

**DUTY L:**
**Self-Guided Applications Using GIS Software and GIS Software Extensions**

**Task:**

**L001: Develop a campus project with a career cluster-focus in an individual or small group setting**

*Definition*: Process should include the following:

- follow detailed project implementation steps to plan and create a GIS project that deals with campus traffic flow. This includes carpool pickup/drop-off, parking facilities, bus circulation, etc. (Engineering/Industrial Technology project)
- follow detailed project implementation steps to plan and create a GIS project that deals with campus emergency/disaster plans including: human and materials inventory of campus, water availability, school scheduling, campus evacuation plans, etc. (Health/Human Services Technology project)
- follow detailed project implementation steps to plan and create a GIS project that studies the vegetation inventory of the campus landscape. This includes recording diverse plant types and their condition, researching their biological profiles, determining indigenous vs. transplanted species, and assessing their suitability for the campus environment. In addition, students may perform a temporal vegetation analysis focusing on change detection from year to year and season to season. (Agriculture/Natural Resources Technology project)
- follow detailed project implementation steps to plan and create a GIS project that deals with the selection of a location for a particular object or area (trash receptacles, playground, garden, portable buildings, etc.) on the school campus. (Multidisciplinary project)
- interview students/school personnel and identify and/or collect necessary data to be used in the project.
- identify and/or collect necessary data to be used in the project
- using GIS software and any necessary extension software programs, manipulate the project data and perform any relevant analyses for the project
- organize findings into a GIS layout, import this layout into a word processing software program, and summarize these findings in a concise written report
- communicate project findings via oral presentation to project stakeholders

Process/Skill Questions

**DUTY M:**
**Meta Data Creation from School-Based Application Data**

**Task:**

**M001: Federal Geographic Data Committee (FGDC) standards for meta data**

*Definition*: Process should include the following:

- describe the function of the Federal Geographic Data Committee (FGDC)
- develop meta data from original data collected from school-based applications following FGDC standards for meta data
- post data, with developed meta data, on an online data clearinghouse

Process/Skill Questions

**SPATIAL PROJECTS AND COMMUNITY EXCHANGE (SPACE)**

**DUTY N:**
**Introduction/Migration to Industry Standard Geospatial Tools**

**Task:**

**N001: Understand concepts of industry standard GIS software**

*Definition*: Process should include the following:

- identify components of upgraded, industry-standard GIS software suite
- identify new terminology related to upgraded, industry-standard GIS software
- navigate GIS software suite interfaces.
- identify and explore new features and functions of upgraded, industry-standard GIS software suite
- identify data types used for upgraded, industry-standard GIS software suite including shapefiles, coverages, raster data and tabular data and demonstrate how each data type is accessed and utilized

Process/Skill Questions

**N002: Demonstrate industry standard GIS software tools**

*Definition*: Process should include the following:

- demonstrate how to import project files created with earlier GIS software versions into upgraded, industry-standard GIS software suite
- demonstrate data conversion functions
- demonstrate data display functions including labeling, editing symbology and classifying data
- identify terminology and concepts relating to geo-referenced data including coordinate system, datum, and map projection
- demonstrate functions relevant to changing coordinate system parameters in GIS software suite.
- demonstrate how to create new data using GIS software suite
- download data from an online source
- identify tools and methods for creating and maintaining metadata using appropriate industry standards
- edit spatial data using appropriate software tools and techniques
- demonstrate tabular data maintenance and editing techniques
- create alternative displays of tabular data including a graph and report
- demonstrate data selection techniques
- explore spatial relationships among geographic data
- create spatial queries
- create map layouts with necessary map elements

Process/Skill Questions

**DUTY O:**
**Applications in Community-Based GIS Class Project Design**

**Task:**

**O001: Problem identification and need**

*Definition*: Process should include the following:

- identify a community problem or situation of sufficient scope to be addressed as a class project using GIS/RS technology
- identify relevant local stakeholders and other interested parties in the project process
- prepare detailed project implementation steps to plan and create a GIS project that deals with a community problem

Process/Skill Questions

**O002: Data analysis**

*Definition*: Process should include the following:

- identify and acquire necessary data to be used in the demonstration project
- manipulate the project data and perform any relevant analyses for the project using GIS software
- manipulate the project data and perform any relevant analyses using extension software programs
- organize findings into a GIS layout

Process/Skill Questions

**O003: Project presentation**

*Definition*: Process should include the following:

- import the project layout and other information into a word processing software program
- summarize project findings in a concise written report
- prepare an oral presentation of the project for administrators, community members, and other relevant parties, including an electronic presentation

Process/Skill Questions

**DUTY P:**
**Self-Guided Applications in Community-Based GIS Project Design**

**Task:**

**P001: Problem identification and research**

*Definition*: Process should include the following:

- identify a school or community problem or situation of limited scope that may be addressed as an individual project using GIS/RS technology
- Identify relevant local stakeholders and other interested parties in the project process
- prepare detailed project implementation steps to plan and create an individual GIS project that deals with a school or community problem

Process/Skill Questions

**P002: Data analysis**

*Definition*: Process should include the following:

- interview necessary residents/community personnel and collect necessary data to be used in an individual project
- manipulate the project data and perform any relevant analyses for the project using GIS software
- manipulate the project data and perform any relevant analyses using extension software programs
- organize findings into a GIS layout

Process/Skill Questions

**P003: Project presentation**

*Definition*: Process should include the following:

- import the project layout and other information into a word processing software program
- summarize project findings in a concise written report
- prepare an oral presentation of the project for administrators, community members, and other relevant parties, including an electronic presentation

Process/Skill Questions

# General Safety

**DUTY : GS (General Safety)**
**General Safety Practices**

**Task:**

**GS001: Follow personal safety guidelines**

*Definition:* Process should include the following:

- identify and comply with personal safety guidelines
- demonstrate understanding of clothing safety guidelines and regulations (hard hat, hard-soled shoes, eye protection, long trousers, shirt with sleeves)
- describe the impact of positive and negative behavior on personal safety
- identify hazards of wearing jewelry while working with tools and equipment

Process/Skill Questions:

- What is the purpose for features of various safety clothing and other safety items?
- What are the steps to identify, report, and correct an unsafe working condition?
- What hazards exist for persons wearing jewelry while working in the laboratory?

**GS002: Utilize tools and equipment safely**

*Definition:* Process should include the following:

- identify and use safe working practices for common hand tools found in the industry
- identify and use safe working practices for equipment and power tools found in the industry
- explain and demonstrate safe working practices related to electrical hazards, including lockout/tagout procedures for inoperable tools and equipment
- inspect hand and power tools to ensure proper working condition
- clean and store tools in an organized manner
- demonstrate safe use of ladders
- describe the use of fall-arrest systems

Process/Skill Questions:

- What injuries may occur if a tool is used improperly?
- What items or conditions should be checked to insure that a ladder is setup properly?
- What conditions will cause a tool or piece of equipment to be unsafe?

**GS003: Comply with fire and hazardous material guidelines**

*Definition:* Process should include the following:

- identify fire hazards and methods for fire prevention
- identify procedures for fire reporting
- describe methods to extinguish fires
- identify appropriate handling for hazardous material information
- describe appropriate techniques for handling and/or disposing hazardous materials
- demonstrate appropriate measures when handling hazardous materials.
- describe information contained on Material Safety Data Sheets (MSDS)
- Locate and interpret Material Safety Data Sheets

Process/Skill Questions:

- What is the procedure for obtaining information for handling a hazardous material?
- Outline the steps to report a fire within the laboratory area.

**GS004: Report injuries**

*Definition*: Process should include the following:

- describe immediate oral reporting of injury to supervisor
- describe procedures to report accident/injury to students or instructor
- describe procedure for a written report of injury, including date, extent of injury, and circumstances

Process/Skill Questions

- What are the necessary steps to report an accident or injury?
- Who should be contacted first in the case of an accident?

**GS005: Inspect work place for safe working environment**

*Definition*: Process should include the following:

- inspect ladders, scaffolding, etc. for unstable or improperly erected condition
- identify location of electrocution hazards in the workplace
- describe procedures for removal of job/worksite debris
- describe conditions for properly storing materials
- identify methods to correct hazardous condition
- describe proper methods of storing materials
- identify air quality hazards

Process/Skill Questions

- What conditions cause a ladder to be unsafe?
- What hazards can be caused by worksite debris?

**GS006: Report unsafe personal, environmental, and equipment safety hazards**

*Definition*: Process should include the following:

- provide oral safety statements based on observation
- document hazards including date, time, location, and persons involved
- submit written safety report to supervisor

Process/Skill Questions

- What is the procedure for oral reporting of a hazardous condition?
- What type Hazards are possible in the laboratory area?

**GS007: Participate in safety training programs**

*Definition:* Process should include the following:

- participate in safety training sessions
- demonstrate knowledge and skills gained from program topics

Process/Skill Questions

- What safety equipment and materials are located in the laboratory area?
- What safety information will help you the most in avoiding injury in the laboratory area?

**GS008: Practice safe lifting and carrying procedures**

*Definition*: Process should include the following:

- describe safe lifting and carrying procedures
- identify possible injury resulting from improper lifting and carrying techniques
- demonstrate safe lifting and carrying techniques

Process/Skill Questions

- What injuries are most likely to occur from improper lifting of a heavy object?
- What weight is considered the heaviest that should be lifted with the arms and legs?

# SkillsUSA
## Task Definitions

| **DUTY A:**<br>**Self - Improvement** |
|---|
| **Task:** |
| **A001: Complete a self-assessment and identify individual learning styles**<br><br>*Definition:* Process should include the following:<br>• Identify and list individual strengths.<br>• Identify and list areas in need of improvement.<br><br>Process/Skill Questions |
| **A002: Discover self-motivation techniques and establish short-term goals**<br><br>*Definition:* Process should include the following:<br>• Develop a list of short-term goals.<br>• Discuss ways to change or improve lifestyle appearance and behavior.<br><br>Process/Skill Questions |
| **A003: Determine individual time-management skills**<br><br>*Definition:* Process should include the following:<br>• Prepare and keep a time journal.<br>• Discuss ways to improve time management skills.<br><br>Process/Skill Questions |
| **A004: Define future occupations**<br><br>*Definition:* Process should include the following:<br>• Search internet for career opportunities within specified fields of study.<br>• Prepare presentation on a specified career area.<br><br>Process/Skill Questions |
| **A005: Develop awareness of cultural diversity and equity issues**<br><br>*Definition:* Process should include the following:<br>• Research a tradition modeled by individual's family.<br>• Develop personal philosophy statements regarding gender equity.<br><br>Process/Skill Questions |

**A006: Define the customer**

*Definition:* Process should include the following:

- Differentiate between External and Internal customers
- Discuss factors which contribute to poor customer relationships.

Process/Skill Questions

**A007: Recognize benefits of doing a community service project**

*Definition:* Process should include the following:

- Discuss and list ways to become involved in the community
- Develop a community service project.

Process/Skill Questions

**A008: Demonstrate effective communication with others**

*Definition:* Process should include the following:

- Identify and list personal barriers to listening.
- Develop personal plan to overcome barriers to listening.

Process/Skill Questions

**A009: Participate in a shadowing activity**

*Definition:* Process should include the following:

- Summarize experience of job shadowing activity.

Process/Skill Questions

**A010: Identify the components of an employment portfolio**

*Definition:* Process should include the following:

- Identify parts of a portfolio
- Design a personal employment portfolio

Process/Skill Questions

**A011: List proficiency in program competencies**

*Definition:* Process should include the following:

- Complete an interpersonal competency assessment.

Process/Skill Questions

**DUTY B:**
**Civic, Social and Business Awareness**

**Task:**

**B001: Measure/modify short-term goals**

*Definition:* Process should include the following:

- Discuss steps to pursue short-term goal(s)

Process/Skill Questions

**B002: Identify stress sources**

*Definition:* Process should include the following:

- List personal sources of stress.
- Discuss techniques to cope with individual sources of stress.

Process/Skill Questions

**B003: Select characteristics of a positive image**

*Definition:* Process should include the following:

- Discuss actions and traits that lead to a positive image.
- Discuss actions and traits that lead to a negative image.

Process/Skill Questions

**B004: Demonstrate awareness of government, professional organizations and trade unions**

*Definition:* Process should include the following:

- Identify state governor, legislators, and senators.
- Identify professional organizations pertaining to specific career areas.

Process/Skill Questions

**B005: Apply team skills to a group project**

*Definition:* Process should include the following:

- Form a team to develop a class project.

Process/Skill Questions

**B006: Observe and critique a meeting**

*Definition:* Process should include the following:

- Attend a formal meeting held within the community
- Critique the attended meeting.

Process/Skill Questions

**B007: Demonstrate business meeting skills**

*Definition:* Process should include the following:

- List and discuss the basic rules to ensure an orderly and business-like meeting

- Role-play appropriate meeting skills

Process/Skill Questions

**B008: Demonstrate social etiquette**

*Definition:* Process should include the following:
- Role-play appropriate social behavior
- Differentiate between good and bad manners.

Process/Skill Questions

**B009: Complete survey for employment opportunities**

*Definition:* Process should include the following:
- Gather information on a particular employment opportunity of interest.
- Conduct internet search of a specific career area.

Process/Skill Questions

**B010: Review a professional journal and develop a 3 to 5 minute presentation**

*Definition:* Process should include the following:
- Develop a presentation on the content, purpose, and distribution of a particular professional journal

Process/Skill Questions

**B011: Identify customer expectations**

*Definition:* Process should include the following:
- List and discuss customer expectations.
- Discuss consequences of unmet customer expectations.

Process/Skill Questions

**B012: Complete a job application**

*Definition:* Process should include the following:
- Obtain a job application from various businesses in the community
- Conduct a mock job interview.

Process/Skill Questions

**B013: Identify a mentor**

*Definition:* Process should include the following:
- Define mentor.
- Discuss ways in which a mentor can help an individual meet career goals.

Process/Skill Questions

**B014: Assemble your employment portfolio**

*Definition:* Process should include the following:

- Develop employment portfolio

Process/Skill Questions

**B015: Explore supervisory and management roles in an organization**

*Definition:* Process should include the following:

- Examine an organizational chart
- Discuss responsibilities of managers and supervisors

Process/Skill Questions

**B016: Recognize safety issues**

*Definition:* Process should include the following:

- Discuss safety issues within a given career area

Process/Skill Questions

**B017: Evaluate your proficiency in program competencies**

*Definition:* Process should include the following:

- Define task and competency
- List competencies associated with a specified career area.

Process/Skill Questions

# Technical And Professional Curriculum Frameworks

## Purpose

This section of the framework contains material to help instructors in technical and professional programs to reinforce basic skills in the areas of Reading and Writing, Math and Science. The technical portion of this guide takes a more direct approach by using specific duty and task listings, but changes in the academic section lead in a more general direction. The reason for this is simple: all good instructors do not teach in the same way. However, all good instructors share the trait of being able to connect their material to everyday life. For example, understanding concepts related to heat, are important for cosmetology students as well as lathe operators in manufacturing plants. However, each program will probably take a different approach in the amount of detail and examples relating to heat concepts. Both groups require basic science knowledge of principles relating to heat, but the application of the principles will be different.

## Basic Skills: The Content Areas

Included in this guide are materials to support basic skills in Reading and Writing, Mathematics, and Science. The overall approach taken here is a move toward problem-solving skills. By problem-solving, we mean the ability to take information and use it for a purpose: to take action, make decisions, predict outcomes, suggest improvements. Another term for these thinking skills is a general "literacy."

Literacy skills have always been in demand in the workplace. A quick review of workplace training programs and other literature regarding adult education demonstrates that the need for a literate workforce is still one of the most pressing problems employers face today. Indeed, many employers (from small- and medium-sized businesses to Fortune 500 companies) have spent hundreds of millions of dollars on in-house basic skills training programs.

What constitutes a literate workforce? There are many definitions for literacy and hundreds of tests that measure it, but when employers are asked what they're looking for in potential new hires, the answers are general: they want individuals who can read and write; show up on time; think and solve problems, and keep their personal lives in order (that is, don't bring a drinking problem into the workplace).

Viewed in this way, the words "literacy" and "literate" are good terms for what educators are trying to instill in their students, the future workforce. The more common definition (being able to read and write) is certainly appropriate but the additional definitions (knowledgeable, educated, well-informed) are also apt. It is this broad term, "literate," that we use to guide instructors on what to cover in the classroom. No matter which Professional and Technical area is being focused on, no matter how technical the terminology is, instructors are given the task of helping students take information, break it down into necessary parts, process details, and be able to come away with an understanding of some sort. This is "literacy", and the process is the same for every subject area-- teaching students how to think and solve problems.

## Format

Each section includes a two-column table. Skills are listed on the left side; suggestions for implementing these skills into the curriculum are listed on the right side. Each suggestion is written in such a way that it can be tailored to most Professional and Technical programs.

## Using The Guide

This guide was prepared with four concepts in mind:

- The instructor is *aware of the need* for students to improve their basic skills.
- The instructor is the *best-qualified person* to decide how to include this material in the classroom or lab. The students' abilities and needs should drive the instructor in deciding how to use, expand, or modify these topics.
- The instructor *already has curriculum that works* for his or her students. Therefore, the suggestions for reinforcing basic skills
    - must be easy to implement
    - must stand alone

- do not need to be taught in a particular order
- must be open-ended enough to be useful for any Technical and Professional program.

- ***Time is limited.*** Unless there are quick ways to reinforce basic skills, changes to the curriculum will not be made. Teaching basic skills in the context of technical material will help students make connections that are more memorable, and will require no additional lesson planning. Just as instructors incorporate updates in technical knowledge, they can add basic skills concepts as well. Adding a few concepts at a time will help students perform better in the lab as well as on tests and evaluations.

## Methods

The following methods may help instructors decide how to increase basic skill knowledge:

- *Collaborative projects*- how could a joint project between regular education teachers and technical instructors reinforce concepts for both programs?
- *Outside assignments*- would students benefit from an outside assignment explaining how a basic math (science, reading) concept ties to a process in the lab?
- *Extra credit*- students needing extra credit can research outside topics and turn in a short summary of material
- "*Need-to-know" assignments*- Students prepare a bulleted list of the basic concepts in science they need to know in order to correctly perform geospatial technology operations in the lab.
- *Question of the Day*- a few daily math problems for students to answer at the beginning of class allows the instructor to set the tone for the material. It also gives students an immediate goal when they enter the classroom and teaches them to stay on task. Bonus points may be awarded at the end of the week, quarter, semester, etc.
- *Two-minute Oral Presentations*- students who need to practice speaking skills can be asked to give a two-minute oral presentation at the end of class summarizing the main points for the day. Or, a two-minute presentation at the beginning of class can recap the material from a previous class.

- *Connecting with Workers*- students can poll parents, friends, area employers or other persons to find out the top 5 basic science skills needed on the job.
- *Direct Questioning*- include a few basic knowledge questions in a presentation. Award points to groups based on correct answers.

## Resources

In creating the Academic Reinforcement material for the technical and professional frameworks, we used a number of source documents and resources.

- The English Language Arts, Science, and Mathematics components of the *Curriculum Improvement Project* by Dr. Willard Daggett were consulted to ensure that the top-ranked skills in those areas would be reflected in the academic support material. The English Language Arts and Science components have many linkages to the material included here. (The higher-level math skills such as trigonometry were not included in this document.)
- Data from work with Arkansas employers- the Workplace Skills Enhancement Program (WSEP) at the University of Arkansas at Little Rock (UALR) has completed many training projects and job profiles for employers in Arkansas. Our constant contact with workers and employers provides a tremendous amount of data that we use in designing customized training programs and in working on projects such as curriculum frameworks. Also, the staff of WSEP has experience teaching in Arkansas public schools, the US military, and the Job Corps.
- Additionally, other groups within UALR (the Labor Education Program, the Institute for Economic Advancement and the College of Business) provide resources regarding health and safety information, labor unions and their role in the workplace, computer and information technology and other training and outreach program data.
- US Department of Labor- the US DOL has many online documents and publications that support workers and issues regarding the workplace. (Work by Philippi and Greenan, 1988 on workplace skills was especially helpful.) Visit the website at www.dol.gov.
- Occupational Safety and Health Administration (OSHA) provides online and other resources for instructors and professionals. For topics relating to safety and health, visit www.osha.gov.

- Multistate Academic and Vocational Curriculum Consortium (MAVCC) is an organization that develops competency-based curriculum. For more on MAVCC see www.mavcc.org.

# ACADEMIC STANDARDS FOR READING AND WRITING
## Strategies for Reinforcement in the Career and Technical Classroom

**Note:**
*** indicates industry-related materials, handouts, notes, etc.**

| **Objective** | **Classroom Applications to Industry** |
|---|---|
| *Present,*<br>*Review and Discuss,*<br>*Master* **the list of skills employers want for the workplace regarding reading and writing.** | Use the list of skills employers want to introduce students to the requirements of the workplace.<br><br>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:<br>• Discussion<br>• Interviewing parents or other adults in the workplace about the skills required<br>• Interviewing employers about the skills in terms of importance<br>• Identifying workplace situations in which certain skills become more important than others<br>• Researching adult education programs to learn why deficits in these areas must be remediated, and the cost spent yearly on these programs<br>• Researching the topic of adult literacy |
| *Answer* **simple comprehension or recall questions from a lecture or from written material.** | Provide 2 examples of workplace materials* on students' reading level.<br><br>With the first, allow students to read information and then answer brief recall questions.<br>With the second example, read aloud the material but do not give a handout. Ask brief recall questions.<br><br>Compare the differences…how do students retain information better—orally or visually? Discuss learning styles and impact on the job. |
| *Follow,*<br>*Give* **oral instructions.** | Using instructions for a hands-on task, have students give <u>oral</u> instructions to a partner or group. Rate the effectiveness of the speaker. |

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| *Follow,*<br>*Give* **written instructions.** | Using a short list of instructions for a hands-on task, have students give written instructions to a partner or group. Rate the effectiveness of the speaker. |
| *Show* **the difference between relevant and irrelevant details.** | Using a copy of workplace materials*, students underline relevant or important details in red, irrelevant or less important details in blue. |
| *Sort* **objects based on x number of criteria.** | Using workplace materials*, sort a group of objects based on characteristics identified by instructor (e.g., by color, shape, defect, or a combination of these). |
| *Recognize,*<br>*Identify* **technical vocabulary.** | Using workplace materials*, highlight technical vocabulary terms.<br><br>Create a class dictionary of industry-related technical vocabulary. Students may add illustrations or diagrams. Each student receives a copy of the final product. Emphasize skills such as alphabetical order, guidewords, prefixes, suffixes, and pronunciation guides. |
| *Read* **aloud.** | Read aloud from workplace materials* in groups or individually. |
| Identify,<br>*Explain* **symbols, abbreviations and acronyms relevant to subject area.** | Using workplace materials*, highlight symbols, abbreviations, and acronyms.<br><br>Create a table with one column for each of symbols, abbreviations, acronyms.<br>Classify each one and write in the meaning. |
| **Understand,**<br>*Use* **rules of grammar, usage, spelling, punctuation.** | Identify the missing punctuation mark, misspelled word, incorrect use of grammar from workplace materials*.<br><br>Correct the mistakes. |
| *Discuss* **uses and purposes of a variety of workplace communication tools.** | Find examples of a business letter, memo, report, brochure, proposal, schematic, map, and diagram. |
| *Duplicate* **process demo by instructor** | Using a workplace process, demonstrate steps |

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| | to complete and have students perform individually or in groups. |
| *Notice,*<br>*Apply* **word analysis techniques.** | Using workplace materials*, identify prefixes, suffixes, or roots that indicate meaning (e.g. therma = heat) [1] |
| *Match* **parts from photographs or diagrams to actual objects.** | Using workplace materials*, follow a sequence of pictures or diagrams to build, create, or copy an item or process. |
| *Read* **for main ideas and for details.** | Use a graphic organizer[1] to show main ideas and supporting details. |
| *Distinguish* **between fact, opinion, and inference.** | Collect examples of materials based on fact or opinion/inference. Ask students to underline key terms that indicate the presence of facts or opinions. |
| *Distinguish* **between rows and columns;**<br>*identify* **a cell as a block where a row and column intersect.** | Using charts or tables from workplace materials*, discuss the reasons for this format.<br><br>Identify the quantity in a particular cell. |
| *Select,*<br>*Use* **appropriate resources and reference tools.** | Explain the uses for the following:<br>Dictionary, Thesaurus, Almanac, Atlas, Card Catalog, Encyclopedia.<br><br>List reasons for choosing one reference tool over another.<br><br>Use reference tools to answer questions related to industry or current events. |
| *Paraphrase* **written or oral material into summary form.** | Using workplace materials*, determine the best way to condense or shorten the material so as to give an overview to a layperson.<br><br>Using a set of guidelines appropriate to students' level in length and detail, summarize the information into bullet points. |

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| *Interpret,*<br>*Fill out/complete* **forms and records.** | Using workplace materials*, answer basic questions (e.g., summarize the list of parts from an inventory).<br><br>Using blank forms or documents, fill in details. Pay close attention to directions. Students critique work with partner.<br><br>Create a form or document to be used in a workplace process. |
| *Use,*<br>*Develop* **a process for remembering details.** | Use pneumatic devices to organize and remember details. Pneumatic devices[1] include Semantic Maps, Thought Webs, and other creative tools to organize thinking. |
| *Proofread,*<br>*Correct* **mistakes in written drafts.** | Using a newspaper article, locate and mark mistakes in grammar, punctuation, or usage.<br><br>Correct mistakes in written drafts. |
| *Examine* **different types of writing used in the workplace (reports, memos, brochures, logs, blueprints, formulas, etc).** | Gather samples of workplace materials*.<br>Identify each by type.<br><br>Compare and contrast the difference between<br>audience, (who the document is written for)<br>length,<br>background information/education needed to understand material,<br>level of detail,<br>organization and layout of the document. |
| *Understand* **the writing process.** | In order to apply the writing process, create a workplace communication tool to be used for a specific purpose.<br><br>Prewrite:<br>Brainstorm, gather facts, or do research to create a business letter, memo, report, brochure, proposal, schematic, map, or diagram.<br><br>Identify the audience. |

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| | Determine the purpose of the document.<br><br>Write:<br>Create a first draft.<br><br>Revise and Edit:<br>Make changes to ensure accuracy.<br><br>Look at the writing from a different point of view.<br><br>Shorten or make more concise where possible.<br><br>Use white space, bold print and other formatting details to make the document easy-to-read.<br><br>Publish:<br>Decide on the best format for the final copy (size, type of material, layout, graphics, etc.)<br><br>Publish the final draft. |

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| *Identify,*<br>*Create* **sentences of different types.** | Using workplace materials*, find sentences of varying types. Examples include<br>Simple Sentences (subject + predicate)<br>Complex Sentences (subject + predicate including clauses).<br><br>Write sentences, paragraphs, or essays using sentences of different types (e.g., write a 2-paragraph summary of today's lesson). |
| *Identify,*<br>*Use* **contractions correctly.** | Using workplace materials*, locate contractions (e.g., isn't, I'll).<br><br>Identify misuses of contractions.<br><br>Write a short list of directions relating to an industry process and use as many contractions as possible. |
| *Identify,*<br>*Use correctly* **commonly misspelled words.** | Using a list of commonly misspelled words[1], locate errors in the media (newspaper articles, Internet sites, magazines.)<br><br>Ask each student to identify his problem words from the list.<br><br>Attempt to incorporate problem words into class activities (e.g., add them to a list of work instructions).<br><br>Give short weekly quizzes focusing on 5 words per week. Award bonus points. |
| *Identify,*<br>*Use* **correctly the English irregular verbs.** | From a list of irregular verbs, review the uses of each.<br><br>Ask each student to identify his problem irregular verbs from the list.<br><br>Attempt to incorporate problem verbs into class activities, such as making a collection of mistakes from print. |
| *Identify,*<br>*Use* **Signal Words and other cues to improve writing.** | Use a list of Signal Words[1] and discuss their purpose in writing (signal words are words that raise a flag to a reader to pay attention.) |

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| | Examples:<br>Signal Words sowing emphasis:<br>Most of all, It should be noted, Of course<br><br>Signal Words showing a conclusion:<br>Lastly, In summary, Finally<br><br>Identify common signal words in workplace writing, especially in sequenced lists.<br><br>Write a list of work instructions using signal words. |
| *Identify* **components of workplace documents such as blueprints, schematics, floor plans, and other industry-related documents.** | Label the parts of a workplace document. |
| *Place* **steps in proper sequence.** | Using a list of steps or pictures cut them apart so that students can place them in the proper order. |
| *Analyze* **cause and effect.** | Experiment with cause and effect in the classroom (e.g., change the sequence of events in a process). |
| *Determine* **missing information.** | Locate the information that is missing from a problem and explain why the problem cannot be solved without it.<br><br>To reinforce concepts, use a completed problem and remove the important details. Ask students if they can identify what's missing. |
| *Differentiate* **between tools used for a job.** | Given a list of tools and a list of functions, identify the most efficient tool for each task. |
| *Assemble* **or disassemble objects.** | From a list of oral or written instructions, assemble an object or complete a process.<br><br>Students write the instructions for disassembly. |
| *Cross-reference* **materials to compare information.** | Using more than one source document, compare the information given. |

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| *Interpret* **reasoning behind rules or regulations.** | Using workplace materials*, make a list of possible reasons or justifications for a safety guideline, regulation, etc. |
| *Show contrasts* **between approaches.** | Given a workplace scenario, write a brief approach to solving the problem. (Working in groups would be beneficial.)<br><br>Compare and contrast each approach from the perspective of a worker, manager, supervisor. |
| *Organize* **data in a new format.** | Using workplace materials*, organize the information into a new format. |
| *Prove* **a rule or method's sufficiency.** | Perform an experiment to determine how much tolerance is acceptable in a case study, (e.g., find the range of drops of red dye sufficient to match the standard red color used in latex paint). |
| *Show* **relationships between two or more systems.** | Using 2 or more partners related to industry, show or explain how they are interrelated (e.g., explain the relationship between social workers and hospitals). |
| **Given examples of emergency situations,** *identify* **real world course of action.** | Using an emergency situation common to your industry, outline a step-by-step plan for action. |
| *Identify* **variables that affect the outcome of a process.** | Experiment with or predict variables that affect the outcomes for a process (e.g., weather patterns that adversely affect a process, such as building a road). |
| *Infer* **situations that meet guidelines when complete information is not available.** | Given a policy or industry standard that has debatable interpretations, list possible situations that can arise that do not have clear solutions in the policy.<br><br>Discuss or debate the issues. |
| *Compare* **finished products to a set of guidelines.** | Compare a set of objects to a set of guidelines (e.g., analyze a batch of parts and document how they do or do not meet a set of Quality Assurance guidelines). |

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| | List any discrepancies (parts that do not meet guidelines) and categorize them by type (e.g., burns, holes, etc). |
| *Identify* **preventative measures for maintenance of a system.** | List the needed routine maintenance to keep a system working properly. |
| *Predict* **new standards or rules that may become necessary in the future.** | Identify recent areas of change or development in your industry.<br><br>Discuss potential future needs or developments that may occur (e.g., potential need for better training requirements for airport personnel). |
| *Improve* **a process by streamlining (locating waste) or decreasing lost time.** | Examine a process in industry in step-by-step detail. Suggest ways to decrease time needed or make the process more efficient.<br><br>Isolate the cause of failure in a process by performing an experiment. |
| *Prepare* **a model explaining a concept.** | Build, draw, or create a model that explains a concept (e.g., show a need for environmental standards for water or air pollution). |

**[1] Fry, Edward; Kress, Jacqueline; Fountoukidis, Dona. *Reading Teacher's Book of Lists,* 4th ed. ISBN 0-13-028185-9.**

# ACADEMIC STANDARDS FOR MATHEMATICS

Strategies for Reinforcement in the Career and Technical Classroom

**Note:**
*** indicates industry-related materials, handouts, notes, etc.**

**Topics Listing**
Problem Solving
Operations and Calculations
Applications
Data Analysis and Display

| **Objectives** | **Classroom Applications to Industry** |
|---|---|
| *Present*<br>*Review and Discuss*<br>*Master* **the list of skills employers want for the workplace regarding mathematics.** | Use the list of skills employers want to introduce students to the requirements of the workplace.<br><br>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:<br>• Discussion<br>• Interviewing parents or other adults in the workplace about the skills required<br>• Interviewing employers about the skills in terms of importance<br>• Identifying workplace situations in which certain skills become more important than others<br>• Researching adult education programs to learn why deficits in these areas must be remediated, and the cost spent yearly on these programs<br>• Researching the topic of adult literacy |
| **PROBLEM SOLVING** | |
| *Examine*<br>***Apply*** **problem**-solving process. | Define the problem<br>What is being asked?<br>Decide on a type of solution<br>Multi-step or single-step question?<br>Try any of these:<br>Estimate an answer<br>Draw a diagram<br>Find a pattern |

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| | Guess and check<br>Logical Reasoning<br>Make a graph<br>Make an organized list<br>Make a table<br>Solve a simpler problem<br>Use a simulation<br>Work backwards<br>Write an equation<br><br>Locate information you need<br>Do you have all the components?<br><br>Get missing information<br>May need to perform some other calculations<br><br>Calculate<br>Look at the answer.<br>How should the remainder be expressed?<br><br>Check the solution<br>Is it reasonable? |
| **OPERATIONS AND CALCULATIONS** | |
| *Read, write*, **and** *count* **numbers.** | Read and write numbers (especially focus on very large and very small numbers where mistakes are common).<br><br>Give a weekly quiz asking students to compare and sequence numbers.<br>Example:<br>0.4445 ___ 0.4455 > or <<br><br>Put these in order from smallest to largest:<br>0.66, 0.677, 0.67 |
| *Round* **numbers.** | Discuss your industry's use of decimals.<br><br>Identify the place values needed to adequately perform a job. For example, a Quality Assurance Technician who works on the line in a manufacturing plant may need to use numbers through the ten-thousandths decimal place. |

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| | Take a series of sample measurements, and round them to the nearest decimal place identified by the instructor. |
| *Estimate* **numbers.** | The skill of making close estimations is tied to understanding accuracy.<br>Discuss real-life situations where estimation is used.<br><br>Discuss the practice of estimation before calculation. Regular practice in estimating before calculating will teach students where they make errors and will increase their estimation skills.<br><br>Discuss work situations where estimation skills are required, and possible consequences of making estimation errors (for example, is an estimate appropriate for inventory purposes? For ordering supplies?) |
| *Compute* **averages.** | Discuss averages in general terms. Calculate the average temperature, average rainfall or precipitation, average number of students per class, and other relevant examples.<br><br>Using workplace materials*, calculate a series of averages.<br>For example:<br>• Take 10 different measurements of a piece of pipe using a micrometer.<br>• Compare the measurements.<br>• Find the average of all the measurements.<br>• Compare the average to the smallest and largest measurement.<br>• Discuss the effects on quality…when is an average an acceptable benchmark measurement? |
| *Calculate* **with whole numbers: perform one-step problems with basic operations.** | Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of addition, subtraction, multiplication, and division. |
| *Perform* **problems that require an** | Using workplace materials*, make a list of |

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| **understanding of the order of operations.** | situations or problems that need more than one step to perform them.<br><br>If the procedures (add, subtract, multiply, divide, etc) are on the same level of importance, such as adding or subtracting, then the order of operations will not impact the way the problem is solved.<br><br>If a problem requires more than one level of operation to solve (example, dividing and adding), work the problem correctly by performing the division part first and then the addition.<br><br>Rework the problem using addition first. Compare the answers.<br><br>Discuss the importance of reasoning skills to verify that an answer makes sense. |
| *Understand* **the relationship between decimals, fractions and percents.** | Make a table comparing fractions, decimals, and percents. |
| *Compute* **with fractions, decimals, and percents, and show understanding of the relationship between them.** | Create sample problems using fractions that relate to everyday situations.<br>▪ Poll the class on interesting topics (favorite food). Convert whole numbers to fractions. Votes- Pizza- 10<br>Salad- 2<br>BBQ- 8<br><br>10+2+8 = 20 (recognize denominator value)<br><br>$\frac{10}{20}$ Pizza $\frac{2}{20}$ Salad $\frac{8}{20}$ BBQ<br><br>▪ Add the fractions.<br>$\frac{10}{20} + \frac{2}{20} + \frac{8}{20} = \frac{20}{20}$<br><br>▪ Convert fraction to whole number. (Total answers equal 1 class's worth of answers.) |

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| | $\frac{10}{20} + \frac{2}{20} + \frac{8}{20} = \frac{20}{20} = 1$<br><br>▪ Convert fractions to percents.<br>$\frac{10}{20}$ means 10 divided by 20 = 0.50<br><br>Move decimal 2 places right.<br>0.50 = 50%<br><br>$\frac{2}{20}$ means 2 divided by 20 = 0.10<br>0.10 = 10%<br><br>$\frac{8}{20}$ means 8 divided by 20 = 0.40<br>0.40 = 40%<br><br>50% + 10% + 40% = 100%<br>Notice the totals add to 100%.<br><br>So, $\frac{20}{20} = 1 = 100\%$<br><br>Using workplace materials*, calculate work-related questions using fractions, decimals, and percents.<br><br>Calculate shipping costs for internet purchases (such as music from amazon.com). |
| *Solve* **formulas and equations.** | Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of equations.<br>▪ Work left to right<br>▪ Use order of operations<br>▪ Place numbers on one side, variables on the other side |
| *Obtain* **squares and square roots.** | Review the methods for calculating squares, square roots, cubes, and cube roots. Use industry-related formulas to demonstrate examples.<br><br>Compare the difference between the 2 common answers to $3^2$ (answer = 9, not 6). |

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| | How would an incorrect value affect the work on the job? |
| **Convert units of measure:** *Recognize* **components of measuring systems (US and metric) for length.** | Discuss industry measures and terms relating to length. |
| **Convert units of measure:** *Recognize* **components of measuring systems (US and metric) for mass/weight.** | Discuss industry measures and terms relating to mass/weight. |
| **Convert units of measure:** *Recognize* **components of measuring systems (US and metric) for volume.** | Discuss industry measures and terms relating to volume. |
| *Measure* **with a certain degree of accuracy.** | Estimate measurements.<br><br>Using workplace materials* and tools, take measurements of work-related and classroom items.<br><br>Depending on ability level, students may measure to the nearest foot, inch, centimeter, etc. |
| **APPLICATIONS** | |
| *Solve* **word problems.** | Help students feel more comfortable with word problems by placing simpler problems in word problem form; or take concepts students have already mastered and ask them to write word problems for each other to solve. |
| *Select/apply* **mathematical formula.** | Review a set of math formulas and then a list of sample problems. Decide which formula(s) apply to each problem. |
| *Understand* **the importance of time in the workplace.** | Using workplace materials*, make a list of workplace scenarios that require using time correctly, such as keeping a time card, or heating a liquid solution for 20 minutes. |
| *Recognize* **components of time systems (clocks and calendars).** | AM and PM<br>Leap Year<br>Military time |

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| *Discuss,*<br>*Identify,*<br>*Understand*<br>**terms relating to measuring time.** | Discuss the units of time measurement and time vocabulary: second, minute, hour, day, week, month, year, leap year, fiscal year, quarter, annual, biannual, etc. |
| *Understand* **that time can be expressed in terms of equivalencies.** | Show the time equivalencies using fractions. For example:<br>1 ½ days = ___ hours<br><br>1 day = 24 hours<br>+ ½ day = +12 hours<br>1 ½ days = 36 hours |
| *Compute* **time conversions.** | Make a table that shows the equivalencies of time units.<br><br>Compute conversion problems at the appropriate level of difficulty. Examples include:<br>• Convert minutes to hours<br>• Convert hours to days<br>• Convert seconds to years. |
| *Calculate* **ratio and proportion.** | Review fractions when discussing ratio and proportion.<br><br>Draw common classroom items to scale by finding a conversion rate (1 foot equals 1 inch).<br><br>Make predictions using ratios. (If each student in class has 3 children, how many children will there be all together? Write the ratios.) |
| *Apply* **geometry principles: Use formulas for measuring shapes of 2 dimensions.** | Determine the formulas that apply to 2 dimensions: perimeter, area, surface area, etc.<br><br>Find perimeter of classroom.<br>Discuss perimeter of objects that are not shaped as perfect squares. How does this change the formula for perimeter?<br><br>Find the area of the tiles on the floor.<br>Find the area of the classroom. |

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| | Review that all areas are expressed in terms of square units (square inches, square miles, etc) |
| *Apply* **geometry principles: Use formulas for measuring shapes of 3 dimensions.** | Review the formulas that apply to 3 dimensions of objects: volume.<br>Find the volume of common objects such as soda cans, pizza boxes, etc.<br>Review that volume is expressed in cubic units.<br><br>Discuss industry-specific needs for these formulas; for example, find the volume of a tank or silo. |
| *Define* **terms relating to money.** | Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles relating to money.<br><br>For more advanced students, include terms and principles of economics, finance, or statistics. |
| *Perform* **one-step problems involving money.** | Make change.<br>Count up (rather than backwards) to make change. |
| *Perform* **multiple-step problems using money.** | Calculate gross and net earnings.<br><br>Calculate<br>▪ Interest<br>▪ Sales tax<br>▪ Percent off<br>▪ Sale price<br>▪ Profit percentages<br><br>Perform banking transactions. |
| *Perform* **business-related financial activities.** | At a level of complexity appropriate to your industry and to students' ability levels, solve income/expense problems, prepare budgets, etc. |
| *Use* **a calculator to perform computations.** | Identify appropriate activities that can be performed using a calculator (calculators |

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| | allow students to concentrate on problem-solving strategies.<br><br>Award prizes for weekly activities or competitions. |
| *Calculate* **measurements taken from measuring devices.** | Add, subtract, multiply and divide measurement numbers by plugging them into formulas. |
| *Perform/prepare* **an inventory.** | Use a sample group of items to prepare an inventory.<br><br>Review inventory vocabulary terms.<br><br>Discuss the math processes that would apply to the inventory process. |
| **DATA ANALYSIS AND DISPLAY** | |
| *Recognize* **types of visual representations.** | Charts<br>Graphs<br>Tables |
| *Interpret* **charts, graphs and tables.** | Answer simple questions about charts, graphs and tables.<br><br>*Solve* multi-step problems involving the correlation of graphs and tables. |
| *Collect/record* **data.** | As appropriate to industry, practice sampling methods. Discuss safety precautions for sampling. Visit OSHA at the Department of Labor website for more details.<br><br>Practice collecting and recording sample data from your industry (such as measurements taken using a micrometer). Compare class answers.<br><br>Find the range of answers (maximum and minimum). Find the average.<br><br>Discuss an acceptable range of answers (±), and graph the results showing the number that fell inside and outside the acceptable range. |

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| *Review **and** apply* **principles of probability.** | Use real-life examples that are highly motivating to direct the students' attention to probability principles.<br>(Example, "I am thinking of a number between 1 and 50. The person who guesses the number will receive that many bonus points if she can tell me the probability of choosing the number correctly.") |
| **Use probability models to** *predict* **chance events.** | Calculate theoretical probability of an event (e.g., the probability of rolling a 5 on a die is 1/6).<br><br>Find empirical probability of an event by performing repeated experiments.<br><br>Compare the 2 probabilities. |
| *Calculate **and** interpret* **statistics.** | Identify the importance of using statistics correctly.<br>Bring examples of statistics from the news or media and analyze them: are they ambiguous? Are they correct? What data is the advertisement trying to get the public to see?<br><br>For a humorous look at statistics, see *How to Lie with Statistics* by Huff and Geis. |
| *Interpret* **plans/blueprints.** | Review vocabulary and terms for plans, blueprints and schematics.<br><br>Build a plan or blueprint one layer at a time, starting with the basic identifying information.<br><br>Add layers of wax paper or other transparent drawing material on top of the first layer that allows each layer to be viewed individually, or the entire drawing as a whole. |
| *Construct* **charts and tables.** | Discuss chart types and chart vocabulary.<br><br>Using workplace or sample data from the class, construct tables and charts. |

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| | For a daily example, consult *USA Today* online and look for the snapshots section that shows a graph of some sort. Ask weekly bonus questions about the data.<br><br>Challenge students to bring in examples of charts and graphs containing errors. |

# ACADEMIC STANDARDS FOR SCIENCE

## Strategies for Reinforcement in the Career and Technical Classroom

**Note:**
*** indicates industry-related materials, handouts, notes, etc.**

*Topics Listing*

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| **General Science-** | topics not specific to a content area |
| **Physical Science-** | Mechanics and Physics |
| | Energy and Waves |
| | Thermodynamics |
| | Electromagnetism |
| | Chemistry |
| | Optics |
| **Life Science-** | Cell biology |
| | Evolution |
| | Genetics and Heredity |
| | Human and Animal Development |
| **Anatomy** | Ecology |
| | Viruses |
| | Bacteria |
| | Plants |
| **Earth Science-** | Earth in space |
| | Solar System/Astronomy |
| | Atmosphere and weather |
| | Oceans and water |
| | Earth resources |

**Note:**
*** indicates industry-related materials, handouts, notes, etc.**

| **Objective** | **Classroom Applications to Industry** |
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| **GENERAL SCIENCE** | |
| *Present,*<br>*Review and Discuss,*<br>*Master* **the list of skills employers want for the workplace regarding science skills.** | Use the list of skills employers want to introduce students to the requirements of the workplace.<br><br>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:<br>• Discussion<br>• Interviewing parents or other adults in the workplace about the skills required<br>• Interviewing employers about the skills in terms of importance<br>• Identifying workplace situations in which certain skills become more important than others<br>• Researching adult education programs to learn why deficits in these areas must be remediated;<br>find out the cost to employers to educate adult workers<br>• Researching the topic of adult literacy |
| *Perform* **computations as required to solve problems.** | Use the metric system to convert units of measure.<br><br>Round numbers to correct number of significant figures.<br><br>Determine percentage of error.<br><br>Understand validity, reliability, accuracy, and precision. |
| *Apply* **scientific method of inquiry.** | Identify the steps of the scientific method.<br><br>Conduct experiments.<br><br>Understand the following terminology:<br>Conclusions vs. inferences<br>Variables<br>Replications<br>Samples/sample size |

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| *Investigate* **science history as it applies to industry.** | In groups, research topics in science pertaining to your industry. Have students assign roles for each member of the group.<br><br>Present findings in report format, or in oral presentations.<br><br>Investigate science ethics.<br><br>Recognize the processes available for accountability in industry. For example, OSHA has a Safety and Health Program Assessment Worksheet whereby employers can be rated for safety issues. See http://www.osha.gov/SLTC/safetyhealth_ecat/mod3.htm<br><br>[Note: Safety and Health is a mandatory subject of bargaining when a workplace is unionized; in both unionized and non-unionized workplaces, an employer cannot create and dominate workplace safety committees (see the National Labor Relations Act).] |
| *Use* **scientific instruments to *measure* aspects of the environment.** | Gather data on time, length, mass, pressure, volume, acceleration or other measurables using instruments from the job. |
| *Demonstrate* **an understanding of data.** | List the processes involved in gathering data.<br><br>Suggest ways that data can be grouped or organized.<br><br>Collect specimens.<br><br>Show how data can be represented (graphically, charts and diagrams, etc)<br><br>Construct a model to depict a basic concept. |
| *Identify* **the seven basic S I (Systeme International) units.** | Length- meter- m<br>Mass- kilogram- kg<br>Time- second- s<br>Electric current- ampere- A |

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| | Temperature- Kelvin- K<br>Amount of substance- mole- mol<br>Luminous intensity- candela- cd<br><br>Dictionary of units- see<br>http://www.ex.ac.uk/cimt/dictunit/dictunit.htm |
| *Identify* **S I (Systeme International) Derived units.** | Choose units appropriate to your industry (hertz, ohm, volt, watt, etc).<br><br>Create a picture dictionary demonstrating the concepts. |
| *Review* **relevant theories, laws and models**. | As relating to your industry, discuss important theories, laws and models. |
| *Use* **reference tools to solve problems.** | Use scientific reference tools (such as the Periodic Table of Elements) to learn more about specific industry concepts. |
| *Practice* **safe lab procedures.** | Handle equipment with care.<br><br>Demonstrate safety and first aid procedures.<br><br>Identify harmful substances. |
| **PHYSICAL SCIENCE** | |
| *Understand* **the cyclical nature of systems.** | Show, demonstrate, model, track the cycles of any of the following systems:<br>Growth and decay<br>Food webs<br>Weather<br>Water |
| *Analyze/classify* **matter according to type.** | Identify types of matter (solids, liquids, gases). Which types are predominantly used in your area of industry? |
| *Explain* **the concepts of work and power.** | Identify machines used in industry.<br><br>Identify how energy levels change when work or power is increased/decreased.<br>Identify fuel sources used in your industry.<br><br>Discuss internal and external combustion. |

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| | Create a model demonstrating the uses of levers and pulleys. |
| *Be familiar* **with concepts of motion.** | Measure acceleration and deceleration<br><br>Understand the relationship between speed and velocity by performing experiments.<br><br>Recognize waves and vibrations as a type of motion.<br><br>Understand action and reaction.<br><br>Review laws pertaining to motion. |
| *Understand* **concepts related to force**. | Show the need for balance of forces acting on an object.<br><br>Observe centrifugal and centripetal forces in action.<br><br>Show how friction is created and must be accounted for in using and preserving equipment.<br><br>Create a chart showing types of lubricants needed in a factory and schedule of maintenance.<br><br>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of<br>inertia.<br><br>Show the relationship between pressure, mass, and weight. |
| *Understand* and *apply* **principles relating to the atom.** | Understand that atoms have a positive, negative or neutral charge. (Classify protons, electrons, and neutrons.)<br><br>Identify ions. |
| *Investigate* **forms of and changes in energy.** | Discuss how energy is measured.<br><br>Observe changes in energy relationships.<br>Identify catalysts and reactants. |

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| | Identify sources of kinetic and potential energy in your industry. |
| *Discuss, apply* **principles of electricity and electric currents.** | Identify types of circuits and switches.<br><br>Show the difference between direct and alternating currents. Give examples of the best/most efficient use of each.<br><br>Determine how electricity is measured, and solve problems using these terms.<br>(Example, use Ohm's law to calculate current, resistance, and voltage.)<br><br>Identify good conductors and insulators, and how to choose them.<br><br>Understand grounding and create a visual display of grounding safety practices.<br>Include the threat of static electricity.<br><br>Show the uses of a vacuum tube by building a model.<br><br>Compare the following ways of generating electricity:<br>Hydroelectricity<br>Motors<br>Solar Power<br>Steam/nuclear<br>Transformers<br>Incandescent (Light)<br>Show the implications for your industry.<br><br>As appropriate to your industry, identify electrochemical energy sources (cells, electrodes, batteries) and the processes of oxidation and reduction. |
| *Be familiar* **with sound waves.** | Compare how sound waves travel between liquids, solids, and air.<br><br>Examine different types (lengths) of sound waves.<br>Examine decibels safe for human hearing.<br>Identify safety precautions for industry regarding sound tolerance. |

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| | Be able to use correctly the terms below as they relate to your industry. (For example, ask students to write a short essay explaining a demonstration from class and include the following terms):<br>Amplification<br>Audible range<br>Frequency<br>Acoustics<br>Resonance<br>Speed |
| *Be familiar* **with principles of heat.** | Differentiate between the 3 types of heat transfer (conduction, convection, radiation).<br><br>Understand that substances expand and contract due to heating and cooling<br><br>Identify purpose and types of insulations used.<br><br>Differentiate between heat and temperature. |
| *Investigate* **and** *apply* **concepts relating to temperature.** | Use the temperature scales; convert between Celsius and Fahrenheit. |
| *Explain* **the concepts of magnetism.** | Understand that currents create magnetic fields.<br><br>Identify materials that are good conductors, and the properties that make them such.<br><br>Understand electromagnetic forces present in earth. |
| *Investigate/apply* **chemical properties.** | Differentiate between acids and bases.<br>Find pH for substances used in industry.<br><br>Identify substances used in your industry and classify them by type.<br><br>Name the major drugs, fertilizers, or additives used in your industry.<br>Define and state examples of chemical reactions.<br><br>Be familiar with solutions used in your industry.<br>Compare saturated and unsaturated solutions.<br>Determine whether a solution is soluble or insoluble. |

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| | Explain solute and solvent. |
| *Investigate* **forms of and changes in matter.** | Compare and contrast physical and chemical changes.<br><br>Discuss the types of physical or chemical changes that take place in your industry, from processing raw materials to manufacturing. |
| *Understand* **and apply concepts relating to the elements.** | Examine the 4 elements that make up 99% of living organisms (Hydrogen (H), Oxygen (O), Nitrogen (N), and Carbon (C)).<br><br>Element Groups:<br>Alkali Metals<br>Alkaline Earth Metals<br>Transition Metals<br>Other Metals<br>Metalloids<br>Non-Metals<br>Halogens<br>Noble Gases<br>Rare Earth Elements |
| *Be familiar* **with principles of light.** | Discuss light as a form of energy.<br><br>Describe types of lighting systems.<br><br>Examine the light spectrum and note the relative smallness of visible light.<br><br>Define reflection and refraction.<br><br>Explain how light carries information (by lasers) and show examples of the impact on technology/industry.<br><br>Identify types of lenses. |
| *Be familiar* **with principles of color.** | Diagram the main parts of the eye involved in seeing color (rods, cones).<br><br>Use prisms to split light into the visible spectrum. Briefly explore color blindness. What precautions should colorblind persons take regarding workplace safety? |

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| | Define situations in which colorblindness impacts a worker's ability to do his job. |
| **LIFE SCIENCE** | |
| *Explain* **the presence of cells as the identifier of all living organisms.** | Examine the cells of organic material used in your industry, using books, the internet, or a microscope.<br><br>Recognize that cells divide or replicate to promote growth of an organism.<br><br>Examine the parts of a cell. Compare the cell to a machine…how do the parts function and rely on each other?<br><br>Give example of one-celled and multiple-celled organisms.<br><br>Review the classification system of all organisms (Kingdom, Phylum, etc).<br><br>Create a circle graph or pie chart (totaling 100%) showing the relationship (in numbers) between the groups of organisms:<br>Bacteria<br>Fungi<br>Viruses<br>Insects<br>Plants<br>Vertebrates<br>Invertebrates<br><br>Compare some of the cell processes (active and passive transport) to the processes in your industry. |
| *Understand* **the progress of evolution of organisms.** | Recognize how a species will adapt to better fit in its environment over time. |
| *Explain* **the role of genetics in human development.** | Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of heredity, including:<br>• Half of an individual's genes are contributed by each parent<br>• Traits that are inherited are either dominant or recessive from the parent(s) |

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| | • Cell division by mitosis versus meiosis<br>• Disabilities are caused either by genetic/inherited conditions (such as Down's Syndrome) or in accidents occurring after birth, such as brain damage due to a car accident or a stroke |
| *Investigate/apply* **principles of human development.** | Describe the life cycle of humans and other animals.<br><br>Use the concept of human development to explain the need for understanding foundation skills in your area. (For example, children do not run before they walk.) Use this concept to explain other events that occur in a natural order in your industry. |
| *Explore* **additional concepts pertaining to humans and other animals.** | Give examples of ways organisms adapt to their environment.<br><br>As relating to industry, review the concepts of:<br>Aging<br>Immune system<br>Skin and Tissues<br>Blood and hemoglobin<br>Disease |
| *Compare/contrast* **the differences between sexual and asexual reproduction.** | Determine instances when understanding the concepts of sexual reproduction are important for your industry.<br><br>Highlight the effects of unsafe working practices on unborn fetuses, or the dangers present for pregnant individuals working in industry. |
| *Show* **a general understanding of the importance of health.** | Explore the cost of lost wages and worker's compensation in the past year due to health problems.<br><br>Research the most common health problems among workers (workers with safe jobs; workers with most hazards to health, etc) |
| *Investigate* **the food cycle.** | Identify food chains, food webs, food pyramids.<br><br>Show how changes to the food cycle affect the |

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| | environment and affect man.<br><br>Name the food groups. |
| *Understand* **nutrition and the body's need for a diet that provides vitamins and minerals.** | Show an understanding of body systems (circulatory, nervous, digestive, etc) as they relate to industry.<br><br>Identify deficient vitamins and minerals among a particular population (American workers, workers in specific environments, workers who do not go outdoors, or who always work outdoors) and the health risks associated with job types (office work, mining work, etc.) |
| *Observe* **health code/sanitation requirements.** | Research the development of health code and sanitation requirements, including OSHA.<br><br>Compare/contrast workplaces of 1850, 1900, 1950, 2000 regarding health and safety.<br><br>Discuss the most common workplace violations of health requirements and present in a graphic format (e.g., maps, charts).<br><br>Discuss potential effects of ignoring health requirements.<br><br>After identifying workplace hazards, create several plans to treat the problem. Debate the benefits of each.<br><br>To avoid the threat of employers choosing ineffective means of ensuring safety on the job, locate MSDS sheets, first aid stations, personal protective equipment, worker's compensation claims offices/paperwork, etc.<br>Using workplace materials*, locate the section on safety regulations. Ask students to rank order the items. Debate the importance of each. Determine the threat of ignoring regulations. Research which regulations are often disregarded.<br>Explore proactive measures students can take to extend their health.<br><br>Understand the importance of mental health in |

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| | addition to physical health. |
| *Investigate/apply* **principles of anatomy and physiology.** | As relating to your industry, explore issues relating to anatomy and physiology.<br><br>Skeletal system- study the bones of the arm, hand, and neck. Research carpal-tunnel syndrome.<br><br>Fractures- identify the types of fractures and those most common to your line of work. Learn how to prevent falls. |
| *Understand* **basic principles of Ecology.** | Define ecology.<br><br>Identify 5 major ways in which man interacts with the environment, especially as relating to your industry.<br><br>Discuss the effectiveness of the media as compared to pro-science groups (such as Greenpeace) on the public's awareness of important environmental issues.<br><br>Identify any areas of concern regarding waste/waste management in your industry.<br><br>Show the difference between a niche, community, habitat, and ecosystem.<br><br>Give examples of herbivores, carnivores, and omnivores. How does your industry use and serve each group?<br><br>Understand predators' effects on food chains. Identify predators of industry.<br>Explain the process of decomposition and decay. How does industry interfere with or interrupt these processes? |
| *State* **the differences between viruses and bacteria.** | Define viruses and bacteria.<br><br>Explore viral and bacterial threats present in the workplace. How can they be prevented? How can they be treated?<br><br>State the benefits of viruses and bacteria. |

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| | Explain the recent increased resistance to drugs and antibiotics. |
| *Understand* **basic concepts relating to plants.** | Describe the interchange of oxygen and carbon dioxide between plants. Contrast to the way humans exchange oxygen and carbon dioxide.<br><br>As relating to industry, review the concepts of:<br>Fertilization<br>Parts of plant, and functions of each<br>Effects of temperature on plants<br>Need for water and light<br>Photosynthesis |
| **EARTH SCIENCE** | |
| *Recognize* **earth's position in the universe.** | As relating to your industry, identify relevant topics regarding<br>Asteroids<br>Comets<br>Stars<br>Galaxies<br><br>Identify planets in the solar system.<br><br>Compare and contrast earth to other planets.<br><br>Create a model showing the relative size of earth within our solar system. Use mathematical relationships to make sure the scale is correct (earth is the size of ___ so the sun should be the size of ___).<br><br>How do the phases of the moon and sun affect the hemispheres? |
| Investigate **history of the earth.** | Identify geological, chemical and other methods of determining the age of an object.<br><br>Demonstrate that fossils and rocks are indicators of previous eras.<br><br>As a class, create a timeline indicating the age of the earth. Include the various ages (Ice Age, etc) and the length of each.<br><br>Make sure the timeline is drawn to scale. |

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| | Assign each Age to a group and research the following:<br>Weather<br>Major events at beginning and end of age<br>Organisms living during this time<br>Factors that made the Age unique |
| *Investigate* **physical characteristics of the earth.** | Label/model the components of the earth.<br><br>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of gravity.<br>Solve problems of longitude, latitude and time zones.<br><br>Create a model of the ratio of land and water on earth. |
| *Investigate* **physical forces acting on the earth.** | Examine erosion and depletion of nonrenewable resources.<br><br>Identify natural disasters such as hurricanes and earthquakes. Research the effects of a past disaster on a specific industry.<br><br>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of plate tectonics (the earth's surface is broken into large plates; movements of these plates over time causes earthquakes and other geologic activity). |
| *Explain* **the basic components of earth's rotation.** | Understand that the earth spins on its axis at an angle of 23 ½ degrees<br><br>Identify the period of one complete rotation as a day; longer cycles of rotations identify the seasons.<br><br>Discuss time zones. |
| *Identify* **the earth's atmosphere and its components.** | Identify the main elements in the earth's atmosphere (nitrogen and oxygen).<br><br>Identify layers of the atmosphere, and the ozone layer. |

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| | Explain concepts of air pressure. |
| *Understand* **basic principles of the solar system.** | Demonstrate how the sun strikes the earth at different angles depending on location. |
| *Demonstrate* **the relationship between climate and weather.** | Identify the factors that create weather.<br><br>Show how landscape features are affected by changes in climate or weather.<br><br>Identify the greenhouse effect. How does industry contribute to it?<br><br>Describe the relationship between altitude and weather.<br><br>Understand that changes in the weather may be seen as fronts that are put in motion by the jet stream.<br><br>Identify types of precipitation.<br><br>Differentiate between types of clouds.<br><br>Understand the effect of winds, wind speeds, and impacts on vegetation. |
| *Learn* **and** *apply* **concepts relating to the oceans.** | Label the major oceans and seas.<br><br>Determine the elements in ocean water (nearly all elements are present).<br>Identify or draw the structural components of the ocean floor.<br><br>Explain the relationship between the moon and the tides.<br><br>Explore ways the ocean is used for power and business. |
| *Investigate* **principles of water.** | Identify the parts of the water cycle and the effects of the processes involved.<br><br>Define water's chemical properties<br>water is the universal solvent<br>water has a neutral ph of 7 |

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| | chemically, water is one atom of oxygen bound to two atoms of hydrogen)<br><br>Measure salinity. Which industries rely heavily on water?<br><br>Define water's physical properties<br>water is the only natural substance that exists as solid, liquid, and gas<br>water's surface has a high density<br>water has a high tolerance for heat (heat index)<br>water's weight<br>water as a coolant<br>specific gravity |
| *Investigate* **conservation of physical and natural resources.** | As relating to your industry, discuss or debate the issues of<br>Allocation of resources<br>Recovering resources<br>Best/worst methods of using resources<br><br>Compare/contrast renewable and nonrenewable resources.<br><br>Note the important developments in your industry regarding mineral, soil, water, and wildlife conservation.<br><br>Discuss alternative sources of energy as relating to your industry. |
| *Investigate* **issues regarding scientific technology.** | As relating to your industry, discuss the uses of technology.<br>What are the newest developments?<br><br>What effects does the technology have on our society? Political system?<br><br>Discuss the role of economics on technology. |
| *Apply* **science principles/laws to environmental issues.** | Discuss how mankind alters the earth and environment through use of resources and technology, pollution. |

# Arkansas's All Aspects of Industry

**Defining "All Aspects"**

All aspects of an industry include, with respect to a particular industry that a student is preparing to enter, planning, management, finance, technical and production skills, underlying principles of technology, labor and community issues, health and safety, and environmental issues related to that industry. Planning is examined at the level of both an individual business and the overall industry. Planning elements might include:

- Developing strategic plans — mission, vision, goals, objectives, and/or a plan of action
- Working with planning tools such as surveys, market research, and competitive analysis
- Anticipating needs for staffing and major purchases of equipment and supplies
- Developing plans for training and upgrading of staff
- Forecasting market trends
- Developing business plans for entrepreneurial ventures.

Management addresses methods typically used to manage enterprises over time within the industry, as well as methods for expanding and diversifying workers' tasks and broadening worker involvement in decisions. Key elements of management might include:

- Using an organization chart to explain how a corporate chain of command works
- Providing input for strategic plans and communicating the company's vision and mission statements
- Leading employees in carrying out strategic plans and action plans
- Evaluating employee performance
- Anticipating technology and other major purchasing needs
- Ensuring equity and access for employees
- Resolving conflicts
- Developing job descriptions and written policies/procedures
- Identifying recruitment procedures, training opportunities, methods of evaluation, and retention strategies
- Working with professional associations and community outreach efforts.

Finance examines ongoing accounting and financial decisions and different methods for raising capital to start or expand enterprises. Finance functions might include:

- Developing budgets
- Preparing financial statements
- Analyzing and managing financial transactions and records
- Implementing payroll procedures
- Determining and paying taxes
- Identifying indirect wage costs (benefits, FICA, insurance, worker's compensation)
- Making loans and granting credit to customers
- Developing graphs and charts related to company finances
- Identifying and implementing methods of sustaining profitability of a business
- Managing 401K plans
- Identifying sources of capital

Technical and Production Skills cover specific production techniques and alternative methods for organizing the production work, including methods that diversify and rotate workers' jobs. Technical and production skills that an employee should have to succeed in a business or industry might include:

- Developing and upgrading job-specific skills
- Using troubleshooting and problem-solving techniques
- Analyzing information to make decisions
- Identifying and implementing quality assurance techniques
- Employing communication skills such as writing, listening, speaking, and reading
- Participating in team efforts
- Implementing projects and new techniques
- Demonstrating basic computer skills; employing time management techniques in completing projects and assigned tasks
- Demonstrating ethical behavior and work ethic.

Underlying Principles of Technology provide an integrated study across the curriculum of the mathematical, scientific, social, and economic principles that underlie the industry's technology. Principles of technology that an employee should know might be demonstrated by:

- Exhibiting proficiency in mathematical and scientific functions related to new and emerging technologies
- Continuously upgrading job skills needed to implement new technologies
- Participating in industry certification programs
- Cross-training to enhance one's value to the organization and to enhance job promotion opportunities
- Understanding and adhering to ethical issues related to technologies.

Labor Issues examine worker rights and responsibilities, labor unions and labor history, and methods for expanding workers' roles. Labor issues might include:

- Understanding and implementing worker rights and responsibilities
- Working with labor unions
- Keeping abreast of local, state, and federal legislation affecting employee and employer rights and responsibilities
- Negotiating and settling worker disputes
- Identifying certification requirements for specific jobs
- Analyzing the impact of labor agreements on business operations.

Community Issues explore the impact of the industry on the community and the community's impact on and involvement with the industry. Concepts of business and community relations might include:

- Developing and working with community outreach projects
- Participating on advisory committees and community organizations
- Working with professional associations
- Developing and implementing public relations plans
- Participating in community service projects.

Health, Safety, and Environmental Issues examine these concepts in relation to both the workers and the larger community. Concepts related to health, safety, and the environment might include:

- Identifying and implementing federal, state, and local regulations related to the health and safety of employees
- Understanding and strictly adhering to federal, state, and local environmental regulations related to the business
- Identifying job-specific health hazards and safety issues
- Identifying and implementing basic safety and first aid training techniques for emergencies such as personal illness or injury, tornadoes, fires, nuclear accidents, floods, and incidences of employee-rage or violent behavior
- Communicating safety regulations and plans to employees

Working with selected community groups to implement safety programs.